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(19) (CA) **CANADIAN PATENT** (12)

(54) **DEAERATOR CIRCUIT FOR BITUMEN FROTH**

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"DEAERATOR CIRCUIT FOR BITUMEN FROTH"

ABSTRACT

5 Bitumen froth streams from the primary separation  
vessel and secondary flotation cells are gravity transferred  
into one or more columns and heated and deaerated therein by  
passing them countercurrent to steam. The heated deaerated  
froth is then pumped with centrifugal pump means to the froth  
treatment circuit. By deaerating and heating before pumping,  
the froth is converted from a form difficult to pump to one which  
10 is relatively easy to pump.

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This invention relates to a method for treating the primary and secondary bitumen froth streams produced from bituminous sands by a hot water extraction process plant. More particularly, it relates to a system for heating and deaerating bitumen froth prior to introducing it into a system for recovery of the bitumen from the deaerated stream.

One of the world's largest reserves of hydrocarbons is contained in the tar sands deposits located in Northern Alberta. Bitumen is presently being recovered from this tar sand using the known hot water extraction process.

In general terms, this process involves mixing tar sand with water, steam and sodium hydroxide in a rotating tumbler to initially disperse the bitumen. A typical slurry issuing from the tumbler comprises 9.5% bitumen, 68.5% solids and 22.0% water (all percents being by weight). The slurry has a temperature of about 180°F and a pH of 8.0 - 9.5. Hot water is added to the slurry to dilute it and provide a stream typically containing 7% bitumen, 50% solids and 43% water. This diluted slurry is then introduced into a cylindrical vessel having a conical bottom. The bulk of the contained coarse sand particles settles out in this vessel and is removed as an underflow and discarded. The more buoyant bitumen particles float to the surface of the vessel to form a froth comprised of bitumen plus entrapped water and solids. This froth overflows the vessel wall and is received in a launder extending around its rim. The product is commonly called "primary froth" and typically comprises 66.4% bitumen, 8.9% solids and 24.7% water. It is usually at a temperature of about 175°F. A middlings stream, typically comprising 2.3% bitumen, 21% fine solids (i.e. - 325 mesh) and 76.8% water, is withdrawn from the mid-section of the settler and is pumped



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to a sub-aeration flotation cell. In the cell, the middlings are vigorously agitated and aerated. The middlings bitumen and some water and solids float to the surface and form "secondary froth". This froth typically compresses 41.4% bitumen, 12.4% solids and 46.2% water. It is recovered in a 5 launder and is then retained in a tank to settle out some water and solids. The settled product typically comprises 41.4% bitumen, 12.4% solids and 46.2% water and has a temperature of 170°F. Heretofore the primary froth and settled secondary froth have 10 been combined and pumped to a heating and deaerating column. In this column the viscosity of the bitumen is reduced from about 1500 centipoise at 160°F to about 500 centipoise at 190°F. The hot deaerated product is then diluted with naphtha and introduced into a centrifuging system to recover clean dilute 15 bitumen.

We have discovered that secondary froth in particular is difficult to pump with centrifugal pumps, due to its viscosity and the high degree of aeration by which it is characterized. When a tar sand containing a high proportion of fine solids is 20 fed to the tumbler, more water has to be used, with the result that more middlings have to be withdrawn. In this circumstance, more secondary froth is produced and the combined froth stream is difficult to pump.

In accordance with the present invention, the primary 25 and secondary froth streams are directly fed by gravity to one or more deaerator columns wherein the streams are heated and deaerated with steam to produce a pumpable mixture of bitumen, water and solids. This mixture is then pumped with one or more centrifugal pumps to the froth treatment circuit.

30 In a preferred embodiment, the secondary froth is passed through a first deaerator column in which it is heated

and deaerated. The primary froth is passed through a second deaerator column. When the first deaerator column is operating inefficiently due to heavy loading, its product can be combined with the primary froth prior to the latter's entry into the second column, with the result that the secondary froth is heated and deaerated twice.

Certain advantages are derived from the practice of the invention. By deaerating the secondary froth before pumping, a head of hot deaerated froth is supplied to the suction of the centrifugal pump. Because it has been heated, the froth is considerably less viscous and the fluid hydraulics of the transfer system are improved. Because it has been deaerated, the froth is more incompressible and hence is more amenable to centrifugal pumping.

One embodiment of the invention is shown in the drawing incorporated into a conventional extraction circuit. More particularly, bituminous sands, hot water, steam and dispersant are fed to a rotating tumbler 1 to produce a thick slurry. The slurry is transferred to a flood cell 2 where it is diluted with hot water. It is then pumped through a line 3 to the primary separation vessel 4. Here primary froth is produced and gravity transferred through the line 5 to a first shed tray tower 6 for deaeration and heating. Steam is introduced into the base of the tower 6 to pass counter-currently to the froth. A middlings stream is withdrawn from the mid-section of the vessel 4 and is pumped through the line 7 to a sub-aerated flotation cell 8. Here the bitumen contained in the middlings is floated to form secondary froth which is gravity transferred through the line 9 to a froth cleaner 10. Solids and water are settled out of the secondary froth in the cleaner 10 and the cleaned froth is gravity transferred through the line 11 into a second shed tower 12

where it is deaerated and heated by steam passing counter-  
currently. The deaerated and heated secondary froth from the  
tower 12 is easily pumped by a centrifugal pump 13 through the  
line 14 to the first tower 6, where the secondary froth is  
5 given a second deaerating and heating treatment. The combined  
froths issuing from the tower 6 are easily pumped by a centri-  
fugal pump 15 to froth treatment facilities.

In summary, the invention is based on the obser-  
vation that centrifugal pumps have difficulty in pumping bitumen  
10 froth which has not been heated and deaerated; as a result, a  
process has been developed whereby the froth has been trans-  
ferred by gravity drainage to deaerating and heating towers  
before being pumped with centrifugal pumps.

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THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE  
PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. In the hot water extraction process for treating tar  
sand wherein primary and secondary froth streams are produced by a  
5 primary separation vessel and a secondary flotation cell, said streams  
comprising mixtures of bitumen, water and solids, and the streams are  
transferred to a froth treatment circuit for recovering the bitumen, the  
improvement which comprises:

10 directly feeding the secondary froth stream by gravity from  
a secondary flotation cell to a first deaerator tower and heating and  
deaerating said stream by passing it countercurrently to steam through  
said tower;

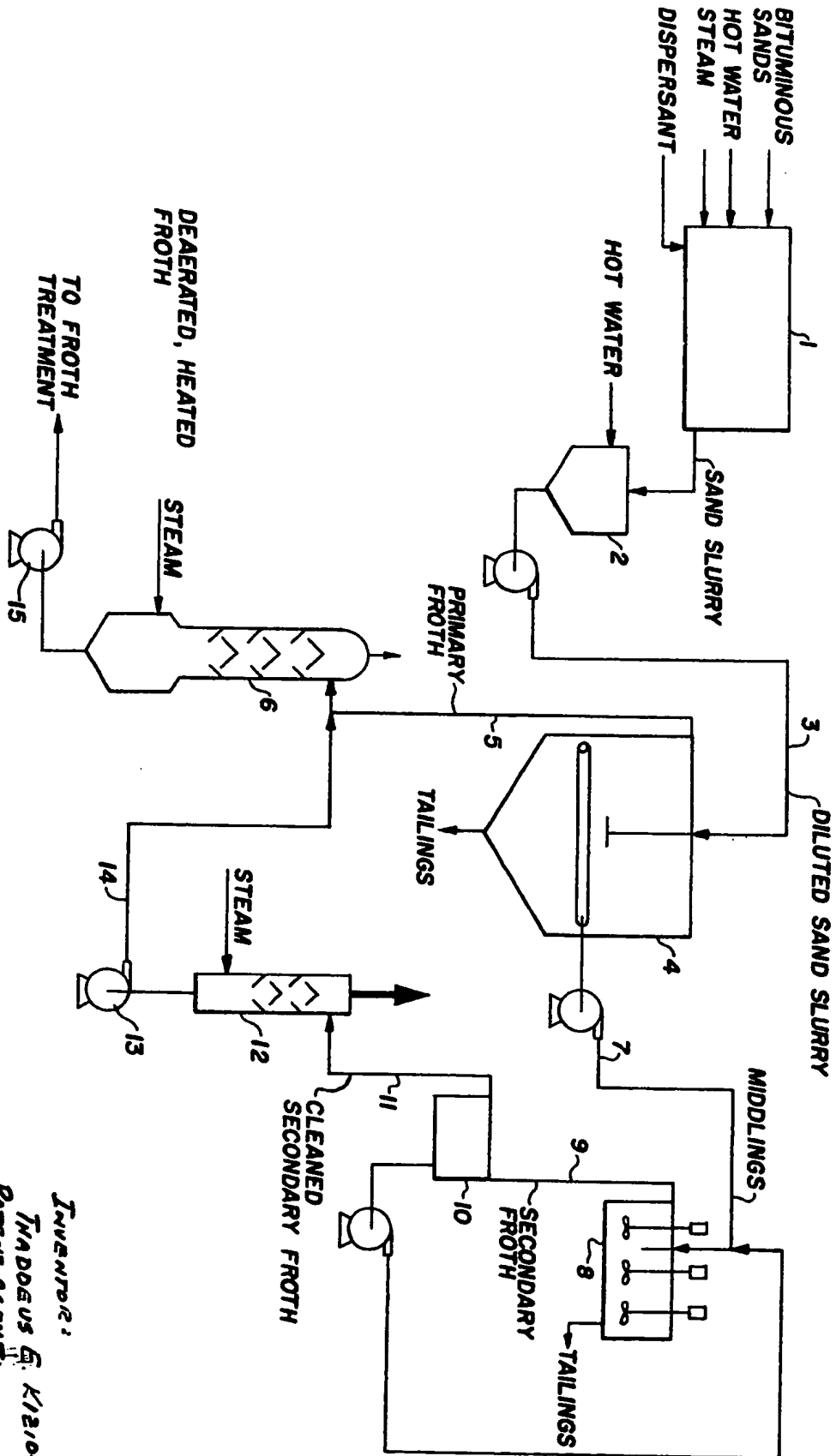
conveying the deaerated secondary froth stream to a second  
deaerator tower;

15 directly feeding the primary froth stream by gravity from a  
primary separation vessel to the second deaerator tower;

passing said streams countercurrently to steam through said  
second tower to heat and deaerate them to provide a pumpable deaerated  
bitumen, water and solids product; and

20 pumping the product with one or more centrifugal pumps to  
the froth treatment circuit.

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